



## PATENT ABSTRACTS OF JAPAN

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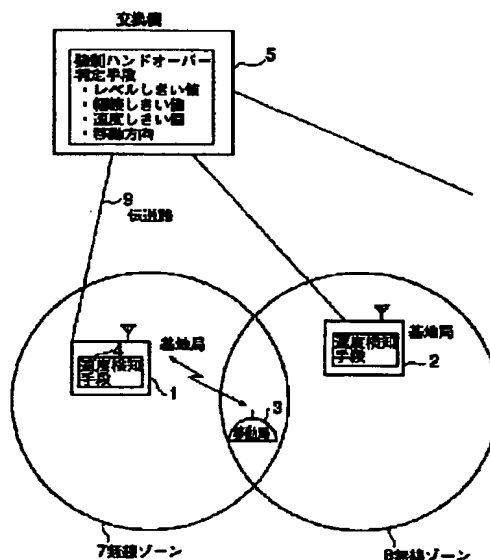
**H04Q 7/22****H04Q 7/28****H04Q 7/36**(21) Application number: **08202357**(71) Applicant: **NEC CORP**(22) Date of filing: **31 . 07 . 96**(72) Inventor: **IWASHITA MASAKAZU**(54) **CONGESTION CONTROL SYSTEM FOR MOBILE COMMUNICATION SYSTEM**

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(57) Abstract:

**PROBLEM TO BE SOLVED:** To reduce the number of times of forces hand-over when the inside of a radio zone reaches a congestion state.

**SOLUTION:** Each of base stations 1, 2 has a means that detects a moving direction and a moving speed of a mobile station 3 during communication based on a fading pitch of a communication radio wave. An exchange 5 has a forced hand-over discrimination means using a reception electric field intensity of a radio wave of a peripheral base station to be measured by each mobile station 3, a moving speed and a moving direction of each mobile station 3 for a discrimination condition. In the case that the congestion state is detected based on a channel use rate, when the reception electric field intensity of the peripheral base station is a prescribed level or over and the moving direction is parted from the base stations 1, 2 or the moving direction cannot be specified, a mobile station whose speed is smaller than a predetermined speed threshold level is extracted and a mobile station 3 with a largest reception electric field intensity is sequentially and forcibly handed over among the mobile stations.



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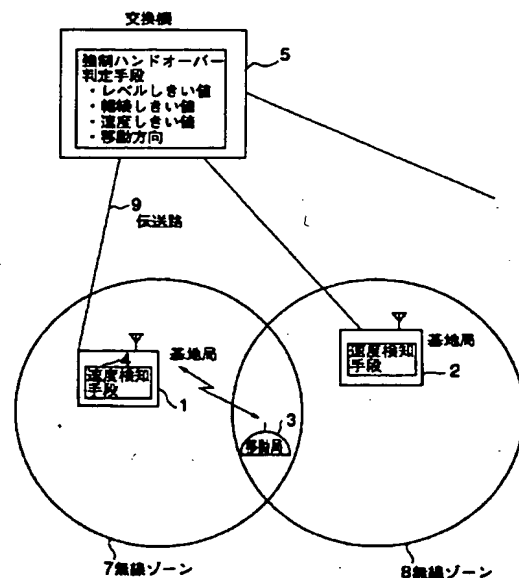
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(54) 【発明の名称】 移動通信システムの輻輳制御方式

(57) 【要約】

【課題】無線ゾーン内が輻輳状態になった際に行う強制ハンドオーバーの回数を低減する。

【解決手段】基地局は通信中の移動局の移動方向、移動速度を通信電波のフェージングピッチにより検知する手段を有する。交換機はチャネル使用率、基地局経由で受信した各移動局が測定した周辺基地局電波の受信電界強度値、各移動局の移動方向および移動速度を判定材料に用いる強制ハンドオーバー判定手段を有する。輻輳状態をチャネル使用率にもとづいて検出すると、強制ハンドオーバーの候補移動局として、周辺基地局の受信電界強度が一定レベル以上あり、移動方向が基地局から遠ざかるか、移動方向が特定できない場合は移動速度があらかじめ定めた速度しきい値よりも小さい移動局を抽出し、それらの中から受信電界強度値が最も大きな移動局から順次強制ハンドオーバーを行う。



## 【特許請求の範囲】

【請求項1】 移動通信制御を司る交換機と、当該交換機に接続された複数の基地局と、各基地局が提供する無線ゾーン内を移動して通信を行う複数の移動局とで構成される移動通信システムにおいて、

前記基地局は、通信中の移動局の移動方向と移動速度を通信電波のフェージングピッチで検出する速度検知手段を備え、

前記交換機は、前記各基地局のチャンネル使用率、基地局経由で受信した各移動局が測定した周辺基地局電波の受信電界強度値、前記基地局が検出した各移動局の移動方向および移動速度を判定材料に用いる強制ハンドオーバー判定手段を備え、

前記強制ハンドオーバー判定手段は、基地局の輻輳状態をチャンネル使用率にもとづいて検出すると、周辺基地局の受信電界強度があらかじめ定められたレベルしきい値より大きく、移動方向が基地局に近づく方向でなく、移動方向が特定できない場合は移動速度があらかじめ定められた速度しきい値よりも小さい移動局を強制ハンドオーバー候補移動局として抽出し、それら候補移動局の中から受信電界強度値が最も大きな移動局から順次強制ハンドオーバーを行うことを特徴とする移動通信システムの輻輳制御方式。

【請求項2】 前記強制ハンドオーバー判定手段は、一つの移動局を強制ハンドオーバーさせる度に輻輳状態を検出し、輻輳状態の解消を検出した時点で強制ハンドオーバーを終了させることを特徴とする請求項1に記載の移動通信システムの輻輳制御方式。

【請求項3】 前記強制ハンドオーバー判定手段は周期的に起動され、前記強制ハンドオーバー候補移動局として抽出したすべての移動局を強制ハンドオーバーさせても輻輳状態の解消を検出できない場合は、当該処理を終了させて次の起動周期を待つことを特徴とする請求項2に記載の移動通信システムの輻輳制御方式。

## 【発明の詳細な説明】

【発明の属する技術分野】 本発明は、移動通信システムに関し、特に、ある基地局の無線ゾーン内に多数の移動局が集中して通話チャンネルが不足する輻輳状態になった際に、周辺基地局にハンドオーバー可能な移動局を強制的にハンドオーバーさせて輻輳状態を解消する移動体通信システムの輻輳制御方式に関するものである。

## 【0001】

【従来の技術】 従来の移動体通信システムでは、無線ゾーンの境界付近にいる移動局を強制ハンドオーバーさせるという方法が取られていた。

【0002】 例えば、特開平4-344723号公報には、移動局毎に自基地局の受信電界強度と隣接基地局の受信電界強度との差分を計算し前記差分を記録保持する機能を基地局制御装置に設け、ハンドオーバー可能な移動局のうち前記差分が最も大きい移動局から強制ハンド

オーバーの候補とする技術が開示されている。

## 【0003】

【発明が解決しようとする課題】 しかし、従来の技術においては、強制ハンドオーバーを行った移動局が高速で移動している可能性があるため、ハンドオーバーを行う前と、ハンドオーバーを行った後とで状態が大きく変わり、強制ハンドオーバーを行った移動局がすぐまたハンドオーバー処理を必要とする可能性があった。

## 【0004】

【課題を解決するための手段】 本発明は、上述した課題を解決して輻輳時に行うハンドオーバーを最小限にとどめる輻輳制御方式を提供する。

【0005】 本発明は、移動通信制御を司る交換機と、当該交換機に接続された複数の基地局と、各基地局が提供する無線ゾーン内を移動して通信を行う複数の移動局とで構成される移動通信システムにおいて、基地局は、通信中の移動局の移動方向と移動速度を通信電波のフェージングピッチで検出する速度検知手段を備え、交換機は、前記各基地局のチャンネル使用率、基地局経由で受信した各移動局が測定した周辺基地局電波の受信電界強度値、前記基地局が検出した各移動局の移動方向および移動速度を判定材料に用いる強制ハンドオーバー判定手段を備え、この強制ハンドオーバー判定手段は、基地局の輻輳状態をチャンネル使用率にもとづいて検出すると、周辺基地局の受信電界強度があらかじめ定められたレベルしきい値より大きく、移動方向が基地局に近づく方向でなく、移動方向が特定できない場合は移動速度があらかじめ定められた速度しきい値よりも小さい移動局を強制ハンドオーバー候補移動局として抽出し、それら候補移動局の中から受信電界強度値が最も大きな移動局から順次強制ハンドオーバーを行うことを特徴とする。

【0006】 また、強制ハンドオーバー判定手段は、一つの移動局を強制ハンドオーバーさせる度に輻輳状態を検出し、輻輳状態の解消を検出した時点で強制ハンドオーバーを終了させる。

【0007】 強制ハンドオーバー判定手段は周期的に起動され、前記の強制ハンドオーバー候補移動局として抽出したすべての移動局を強制ハンドオーバーさせても輻輳状態の解消を検出できない場合は、当該処理を終了させて次の起動周期を待つことを特徴とする。

【0008】 このように、本発明は、強制ハンドオーバーさせても確実にハンドオーバーすることが明らかな条件の移動局を選択する。その条件には、周辺基地局の受信電界強度に加えて、基地局が検出した移動局の移動方向や移動速度を考慮する。

## 【0009】

【発明の実施の形態】 次に、本発明の実施の形態について図面を参照して説明する。

【0010】 図1は、本発明の一実施の形態の構成を示すブロック図である。各々が無線ゾーン7、8を形成し

ている基地局1、2と移動通信制御を司る交換機5は伝送路9により接続されている。交換機5は、通信を許可する受信電界強度レベルしきい値と輻輳を判断するチャンネル使用率にもとづく輻輳しきい値と強制ハンドオーバーを許可する移動局の移動速度しきい値さらには移動方向等による強制ハンドオーバー判定手段6を持つ。基地局1、2は通信中の移動局3の移動速度および移動方向をフェージングピッチによって検出する速度検知手段4を持つ。

【0011】次に、本発明の実施の形態の動作を図2を参照して説明する。

【0012】図2は、本発明の輻輳制御方式の動作を説明するフローチャートである。本動作は、交換機5において周期的に実行されて、輻輳状態の識別、そして輻輳の場合に強制ハンドオーバーを実行して輻輳解消を試みるものである。

【0013】図1においても説明したように、交換機5は強制ハンドオーバー判定手段において、各基地局のチャンネル使用率、基地局経由で受信した各移動局が測定した周辺基地局から放射されている電波の受信電界強度値、基地局が測定して送信してきた各移動局の移動方向および移動速度を判定材料に用いる。

【0014】移動局の移動方向および移動速度は、基地局において通信電波のフェージングピッチを用いて測定する。したがって、測定できる方向と速度は、基本的に基地局と移動局を結んだ直線方向成分の値となり、特に、移動方向は基地局に向かう方向か遠ざかる方向かを判定する。

【0015】図2の動作が交換機5で起動されると、各基地局のチャンネル使用率をあらかじめ定められた輻輳しきい値と比較し、チャンネル使用率が輻輳しきい値を超えた場合に輻輳状態と判定する(ステップ101: Yes)。輻輳状態でない場合(ステップ101: No)は、処理を終了して次の起動周期を待つ。

【0016】輻輳状態と判定した場合は、その基地局において通信しているすべての移動局を対象として、強制ハンドオーバーを行える可能性のある移動局を抽出する(ステップ102)。この抽出条件は、移動局が測定して通知してきた周辺基地局の受信電界レベルがあらかじめ定められたレベルしきい値より大きく、移動方向が基地局に近づく方向でなく、移動方向が特定できない場合は移動速度があらかじめ定めた速度しきい値よりも小さいものとし、これらの条件を満たす移動局はすべて強制ハンドオーバーの候補として抽出する。

【0017】このようにして抽出した移動局の中で、周辺基地局の受信電界レベルが最大の移動局を強制ハンドオーバーの対象移動局として選択する(ステップ103)。

【0018】選択された移動局に対して強制ハンドオーバーの指示を与えてハンドオーバーを行う(ステップ104)。

【0019】ここで交換機5は、この強制ハンドオーバーにより輻輳状態が解消されたか否かを再度チャンネル使用率にもとづいて判定する(ステップ105)。もし、輻輳状態が解消されていれば処理を終了させて次の起動周期を待つ(ステップ105: No)。

【0020】しかし、この強制ハンドオーバーでも輻輳状態が解消されていない場合(ステップ105: Yes)は、さきほど抽出した強制ハンドオーバー候補の移動局の中からステップ103と同じ条件で、次の強制ハンドオーバーの対象移動局を選択して強制ハンドオーバーを行わせる。このとき、もし抽出条件に合致した移動局が存在しなかった場合(ステップ106: No)は、処理を終了させて次の起動周期を待つ。

【0021】このようにして、強制ハンドオーバー候補移動局を順次強制ハンドオーバーさせて輻輳状態の変化を確認し、輻輳状態が解消されるまで同様の動作を繰り返す。もし、その過程で強制ハンドオーバー候補移動局が存在しなくなった場合は、処理を終了させて次の起動周期を待つ。

【0022】

【発明の効果】以上に説明したように、本発明の移動通信システムの輻輳制御方式は、強制ハンドオーバーの候補となる移動局を抽出する際に、明らかに基地局から遠ざかって行くと判断できる移動局や、基地局との距離の変化はないが基地局を中心とした円周の接線方向に移動している移動局で移動速度が遅い移動局など、強制ハンドオーバーしたならば確実にハンドオーバーできる移動局を候補に選び、それらの中から周辺基地局の電波の受信電界強度値が最も高いものから順次強制ハンドオーバーさせるので、同じ移動局に対して再度ハンドオーバーさせるようなことはなく、また、確実に輻輳状態を解消できるという効果を奏する。

【図面の簡単な説明】

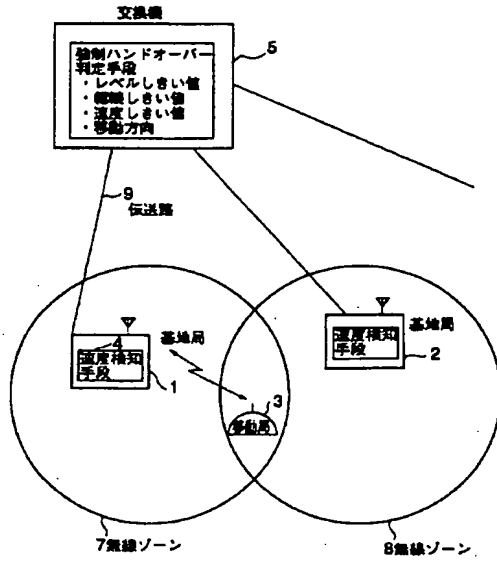
【図1】本発明の一実施の形態の構成を示すブロック図である。

【図2】本発明の動作を説明するフローチャートである。

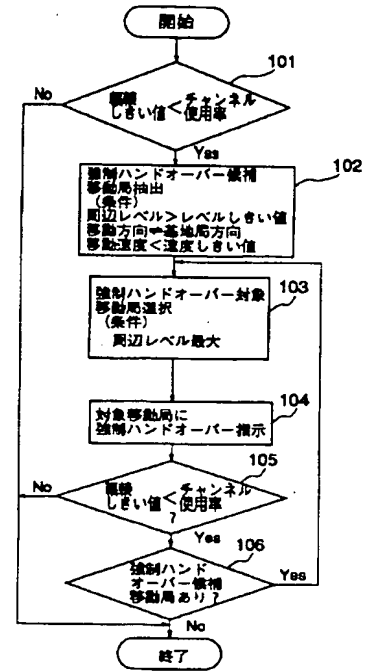
【符号の説明】

- 1, 2 基地局
- 3 移動局
- 4 速度検知手段
- 5 交換機
- 6 強制ハンドオーバー判定手段
- 7, 8 無線ゾーン
- 9 伝送路

【図1】



【図2】



JP-A 10-51836

[Title of the Invention]

CONGESTION CONTROL SYSTEM OF MOBILE COMMUNICATION SYSTEM

[Abstract]

[Problem to be Solved]

To decrease the number of times of forced hand-over which is carried out at the time when the interior of a radio zone is in a congested state.

[Means for Solving the Problem]

A base station has a means which detects, by a phasing pitch of communication radio waves, a moving direction and a moving speed of a mobile station which is currently calling. An exchange device has a forced hand-over judging means which uses, as judging materials, channel use rates, a reception electric field intensity value of peripheral base station radio waves which are measured by respective mobile stations and are received via the base station, and the moving directions and the moving speeds of the respective mobile stations. When a congested state is detected on the basis of the channel use rate, mobile stations, at which the reception electric field intensity of a peripheral base station is greater than or equal to a predetermined level and whose moving direction is a direction of moving away from the base station, or in a case in which the moving direction cannot be specified, whose moving speed is less than a predetermined speed threshold value, are extracted as candidate mobile stations for forced hand-over.

From these, forced hand-over is carried out successively from the moving station at which the reception electric field intensity is greatest.

[Claims]

1. In a mobile communication system which is formed from an exchange device which governs mobile communication control, a plurality of base stations which are connected to the exchange device, and a plurality of mobile stations which move and carry out communication in radio zones which are presented by the respective base stations,

a congestion control system of a mobile communication system wherein:

the base station has a speed detection means which detects, by a phasing pitch of communication radio waves, a moving direction and a moving speed of a mobile station which is currently calling;

the exchange device has a forced hand-over judging means which uses, as judging materials, channel use rates of the respective base stations, a reception electric field intensity value of peripheral base station radio waves which are measured by the respective mobile stations and are received via the base station, and the moving directions and the moving speeds of the respective mobile stations which are detected by the base station; and

when the forced hand-over judging means detects a congested state of the base station on the basis of the channel use rate,

in a case in which the reception electric field intensity of the peripheral base station is greater than a predetermined level threshold value and the moving direction is not a direction of moving toward the base station and the moving direction cannot be specified, the forced hand-over judging means extracts, as forced hand-over candidate mobile stations, mobile stations whose moving speeds are less than a predetermined speed threshold value, and carries out forced hand-over successively starting from the mobile station having the greatest reception electric field intensity value among the candidate mobile stations.

2. A congestion control system of a mobile communication system according to claim 1, wherein the forced hand-over judging means detects a congested state each time one mobile station is forcibly handed over, and completes forced hand-over at a point in time when overcoming of the congested state is detected.

3. A congestion control system of a mobile communication system according to claim 2, wherein the forced hand-over judging means is periodically started, and in a case in which overcoming of the congested state cannot be detected even if all of the mobile stations which were extracted as forced hand-over candidate mobile stations have been forcibly handed-over, the forced hand-over judging means completes the processing and waits for a next start period.

[Detailed Description of the Invention]



[Technical Field to Which the Invention Belongs]

The present invention relates to a mobile communication system, and in particular, relates to a congestion control system of a mobile communication system which, at the time of a congested state in which call channels are insufficient due to a large number of mobile stations concentrating within a radio zone of a given base station, overcomes the congested state by forcibly handing-over, to a peripheral base station, mobile stations which can be handed-over.

[0001]

[Conventional Art]

In a conventional mobile communication system, a method in which mobile stations, which are near a border of a radio zone, are forcibly handed-over has been adopted.

[0002]

For example, Japanese Patent Application Laid-Open (JP-A) No. 4-344723 discloses a technique in which a base station control device is provided with the functions of computing a difference between the reception electric field intensity of a local base station and the reception electric field intensity of an adjacent base station for each mobile station, and recording and holding the difference. Mobile stations are selected as candidates for forcible hand-over, from among the mobile stations at which hand-over is possible, starting from the mobile station having the greatest difference.

[0003]

[Problems to be Solved by the Invention]

However, in the conventional art, because there is the possibility that the mobile station which carries out forced hand-over is moving at high speed, the state may greatly change before carrying out hand-over and after carrying out hand-over, and there is the possibility that a mobile station which has carried out forced hand-over must carry out hand-over processing right away again.

[0004]

[Means for Solving the Problems]

The present invention provides a congestion control system which solves the problems described above, and which keeps hand-over, which is carried out at the time of congestion, to a minimum.

[0005]

In a mobile communication system which is formed from an exchange device which governs mobile communication control, a plurality of base stations which are connected to the exchange device, and a plurality of mobile stations which move and carry out communication in radio zones which are presented by the respective base stations, the present invention is characterized in that: the base station has a speed detection means which detects, by a phasing pitch of communication radio waves, a moving direction and a moving speed of a mobile station which is currently calling; the exchange device has a forced hand-over judging means which uses, as judging materials, channel use rates of the respective base stations, a reception electric field intensity value of peripheral base station radio

waves which are measured by the respective mobile stations and are received via the base station, and the moving directions and the moving speeds of the respective mobile stations which are detected by the base station; and when the forced hand-over judging means detects a congested state of the base station on the basis of the channel use rate, in a case in which the reception electric field intensity of the peripheral base station is greater than a predetermined level threshold value and the moving direction is not a direction of moving toward the base station and the moving direction cannot be specified, the forced hand-over judging means extracts, as forced hand-over candidate mobile stations, mobile stations whose moving speeds are less than a predetermined speed threshold value, and carries out forced hand-over successively starting from the mobile station having the greatest reception electric field intensity value among the candidate mobile stations.

[0006]

Further, the forced hand-over judging means detects a congested state each time one mobile station is forcibly handed over, and completes forced hand-over at a point in time when overcoming of the congested state is detected.

[0007]

The forced hand-over judging means is periodically started, and in a case in which overcoming of the congested state cannot be detected even if all of the mobile stations which were extracted as forced hand-over candidate mobile stations have been forcibly handed-over, the forced hand-over judging means

completes the processing and waits for a next start period.

[0008]

In this way, even if forced hand-over is carried out, the present invention selects a moving station having the condition that it is clear that hand-over is reliable. As this condition, in addition to the received electric field intensity of the peripheral base station, the moving direction and the moving speed of the mobile station, which are detected by the base station, are considered.

[0009]

[Embodiment of the Present Invention]

Next, an embodiment of the present invention will be described with reference to the drawings.

[0010]

Fig. 1 is a block diagram showing the structure of an embodiment of the present invention. Base stations 1, 2, which respectively form radio zones 7, 8, and an exchange device 5, which governs mobile communication control, are connected by transmission paths 9. The exchange device 5 has a forced hand-over judging means 6 by a reception electric field intensity level threshold value which permits communication, a congestion threshold value based on a channel use rate which judges congestion, and a moving speed threshold value of the mobile station which permits forced hand-over, as well as a movement direction and the like. The base stations 1, 2 have a speed detecting means 4 which detects, by a phasing pitch, the moving speed and the moving direction of a mobile station

3 which is currently calling.

[0011]

Next, the operation of the embodiment of the present invention will be described with reference to Fig. 2.

[0012]

Fig. 2 is a flowchart explaining the operation of the congestion control system of the present invention. This operation is carried out periodically by the exchange device 5, and is to identify a congested state, and when there is congestion, to try to eliminate the congestion by executing forced hand-over.

[0013]

As described in Fig. 1 as well, the exchange device 5 uses, as judging materials at the forced hand-over judging means, the channel use rates of the respective base stations, the reception electric field intensity value of radio waves which are emitted from the peripheral base station and which are measured by the respective mobile stations and are received via the base station, and the moving directions and the moving speeds of the respective mobile stations which are measured and transmitted by the base station.

[0014]

The moving directions and the moving speeds of the mobile stations are measured at the base station by using the phasing pitch of the communication radio waves. Accordingly, the direction and the speed which can be measured are basically values of the straight line direction component connecting the

base station and the mobile station. In particular, it is judged whether the moving direction is a direction of heading toward the base station or a direction of moving away from the base station.

[0015]

When the operation of Fig. 2 is started at the exchange device 5, the channel use rate of each base station is compared with a congestion threshold value which is predetermined. In a case in which the channel use rate is greater than the congestion threshold value, it is judged that there is a congested state (step 101: Yes). In a case in which it is not a congested state (step 101: No), the processing is completed and the next start period is waited for.

[0016]

In a case in which it is judged that there is a congested state, all of the mobile stations which are communicating at that base station are considered to be objects, and the mobile stations at which there is a possibility that forced hand-over can be carried out are extracted (step 102). The conditions for extraction are that the reception electric field level of the peripheral base station, which the mobile station has measured and notified, is greater than the predetermined level threshold value, and the moving direction is not a direction of moving toward the base station, and in a case in which the moving direction cannot be specified, the moving speed is less than a predetermined speed threshold value. All of the mobile stations which satisfy these conditions are extracted as

candidates for forced hand-over.

[0017]

Among the mobile stations which are extracted in this way, the mobile station having the greatest reception electric field level of the peripheral base station is selected as the object mobile station for forced hand-over (step 103).

[0018]

The selected mobile station is given instructions for forced hand-over, and hand-over is carried out (step 104).

[0019]

Here, on the basis of the channel use rate, the exchange device 5 judges again whether the congested state has been overcome by the forced hand-over or not (step 105). If the congested state has been overcome, the processing is completed and the next start period is waited for (step 105: No).

[0020]

However, in a case in which the congested state has not been overcome even by the forced hand-over (step 105: Yes), under the same conditions as in step 103, the next object mobile station for forced hand-over is selected from among the mobile stations which are forced hand-over candidates which were extracted before, and forced hand-over is made to be carried out. At this time, in a case in which a mobile station which meets the conditions for extraction does not exist (step 106: No), processing is completed and the next start period is waited for.

[0021]

In this way, the forced hand-over candidate mobile stations are successively forcibly handed-over, and the change in the congested state is confirmed, and the same operations are repeated until the congested state is overcome. If, in this process, forced hand-over candidate mobile stations cease to exist, processing is completed and the next start period is waited for.

[0022]

[Effects of the Invention]

As described above, at the time of extracting mobile stations which are candidates for forced hand-over, the congestion control system of the mobile communication system of the present invention selects, as candidates, the mobile stations which can be reliably handed-over if forced hand-over is carried out, such as mobile stations which are judged to be clearly moving away from the base station, mobile stations which are mobile stations whose distance from the base station does not change but are moving in a direction tangential to a circumference centered around the base station and whose moving speed is slow, and the like. Among the candidates, the congestion control system of the mobile communication system of the present invention forcibly effects hand-over, successively starting from the mobile station having the highest reception electric field intensity value of the radio waves of peripheral base station. Thus, the congestion control system does not hand-over the same mobile station again, and can reliably overcome the congested state.



[Brief Description of the Drawings]

Fig. 1 is a block diagram showing the structure of an embodiment of the present invention.

Fig. 2 is a flowchart explaining operation of the present invention.

[Explanation of the Reference Numerals]

- 1, 2 base stations
- 3 mobile station
- 4 speed detecting means
- 5 exchange device
- 6 forced hand-over judging means
- 7, 8 radio zones
- 9 transmission path

FIG. 1

1: BASE STATION

4: SPEED DETECTING MEANS

2: BASE STATION

SPEED DETECTING MEANS

3: MOBILE STATION

5: EXCHANGE DEVICE

FORCED HAND-OVER JUDGING MEANS

- LEVEL THRESHOLD VALUE
- CONGESTION THRESHOLD VALUE
- SPEED THRESHOLD VALUE
- MOVING DIRECTION

7: RADIO ZONE

8: RADIO ZONE

9: TRANSMISSION PATH

FIG. 2

START

101: CONGESTION THRESHOLD VALUE < CHANNEL USE RATE

102: FORCED HAND-OVER CANDIDATE MOBILE STATION EXTRACTION  
(CONDITIONS)

PERIPHERAL LEVEL > LEVEL THRESHOLD VALUE

MOVING DIRECTION  $\div$  BASE STATION DIRECTION

MOVING SPEED < SPEED THRESHOLD VALUE

103: FORCED HAND-OVER OBJECT MOBILE STATION SELECTION  
(CONDITION)

PERIPHERAL LEVEL GREATEST

104: GIVE FORCED HAND-OVER INSTRUCTION TO OBJECT MOBILE STATION  
105: CONGESTION THRESHOLD VALUE < CHANNEL USE RATE?  
106: IS THERE A FORCED HAND-OVER CANDIDATE MOBILE STATION?  
END